COLLECTOR PANEL FOR SOLID POLYMER FUEL CELL

Publication number: JP2001250568
Publication date: 2001-09-14
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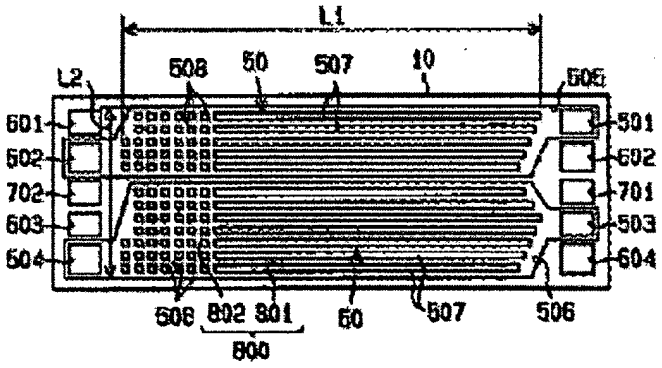
Classification:
- International: ***H01M8/02; H01M8/10;*** **H01M8/02; H01M8/10;** (IPC1-7): H01M8/02; H01M8/10
- European:
Application number: JP20000059313 20000303
Priority number(s): JP20000059313 20000303

Abstract of **JP2001250568**

PROBLEM TO BE SOLVED: To provide a collector panel for a solid polymer fuel cell, capable of maintaining proper power generation efficiency and repressing occurrence of closure with water liquidized in the lower side of a gas path. SOLUTION: A collector panel 10 is installed between a pair of electrolyte membranes of a solid polymer fuel cell. In the collector panel 10, plural fuel gas paths 50 are formed on a face opposed to an anode installed in one electrolyte membrance. In the collector panel 10, plural oxidizing gas paths that allow oxidizing gas to flow in reverse to a gas flow in the gas paths 50, are formed in a face counterposed to a cathode installed in another membrane. In each gas path, plural continuous paths passing through adjacent paths are formed, in which the density of formation for these paths is designed to be larger on downstream side for a gas flow.



(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－250568
（P2001－250568A）
(43)公開日　平成13年９月14日(2001.9.14)

(51)Int.Cl.'	識別記号	ＦＩ		テーマコード'(参考)
Ｈ０１Ｍ　8/02		Ｈ０１Ｍ　8/02	Ｒ	5Ｈ０２６
			Ｂ	
8/10		8/10		

審査請求　未請求　請求項の数5　ＯＬ　（全８頁）

(21)出願番号　特願2000－59313(P2000－59313)

(22)出願日　平成12年３月３日(2000.3.3)

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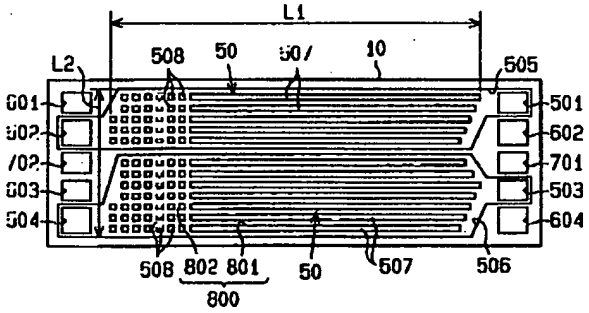
Ｆターム(参考)　5H026 AA06 CC03 CC08 HH03

(54)【発明の名称】　固体高分子型燃料電池の集電板

(57)【要約】
【課題】ガス通路の下流側に液化した水分による閉塞が発生するのを抑え、良好な発電効率を維持することのできる固体高分子型燃料電池の集電板を提供する。
【解決手段】集電板１０は、固体高分子型燃料電池の一対の電解質膜の間に配設される。集電板１０において、一方の電解質膜に設けられた陰極と対向する面には、複数の燃料ガス通路５０が形成される。また、集電板１０において、他方の電解質膜に設けられた陽極と対向する面には、燃料ガス通路５０におけるガス流れ方向と逆向きに酸化剤ガスを流すための複数の酸化剤ガス通路が形成される。各ガス通路には隣り合う通路を連通する連通路が複数形成され、この連通路の形成密度はガス流れ方向の下流側ほど大きく設定される。



【特許請求の範囲】
【請求項１】燃料ガス及び酸化剤ガスを対向する向きに流すための燃料ガス通路及び酸化剤ガス通路が電解質膜を挟んでその両側に設けられる固体高分子型燃料電池に用いられ、前記各ガス通路の少なくとも一方が前記電解質膜との積層面に形成される固体高分子型燃料電池の集電板において、
前記ガス通路は複数の流路により構成され、それら隣り合う流路を連通する連通部が複数形成されるとともに、その連通部による連通度合いがガス流れ方向の下流側ほど大きく設定されることを特徴とする固体高分子型燃料電池の集電板。
【請求項２】前記ガス通路は上流側部分が平行溝により形成されるとともに下流側部分が格子溝により形成される請求項１に記載の固体高分子型燃料電池の集電板。
【請求項３】前記平行溝は屈曲部分のない直線状に形成される請求項２に記載の固体高分子型燃料電池の集電板。
【請求項４】前記ガス通路はガス流れ方向における長さＬ１がガス流れ方向と直交する方向における長さＬ２よりも長く設定される
請求項１乃至３のいずれかに記載の固体高分子型燃料電池の集電板。
【請求項５】前記ガス流れ方向における長さＬ１とガス流れ方向と直交する方向における長さＬ２とがＬ１／Ｌ２＞２なる関係を有して設定される請求項４に記載の固体高分子型燃料電池の集電板。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、電解質膜との積層面に燃料ガス通路及び酸化剤ガス通路の少なくとも一方が形成される固体高分子型燃料電池の集電板に関する。
【０００２】
【従来の技術】固体高分子型の燃料電池では、固体高分子材料からなる電解質膜と、この電解質膜を両側から挟むようにして設けられた反応電極（陽極及び陰極）とによって１つのセル（単位セル）が構成されている。そして、陰極に水素を含む燃料ガスを接触させるとともに、陽極に酸素を含む酸化剤ガスを接触させ、陰極から電解質膜を通過して陽極に移動する水素イオンと同陽極の酸素とが還元反応して水が生成される際に生じる電気的エネルギを各反応電極から取り出すようにしている。
【０００３】また通常、固体高分子型の燃料電池では、１つの単位セルだけでは取り出すことのできる起電力に限りがあるため、各単位セルと集電板と呼ばれる部材とを交互に複数積層することにより所望の起電力を得るようにしている。この集電板は例えばカーボン等の導電材料によって形成されており、各反応電極を電気的に接続する機能の他、各反応電極の表面との間に燃料ガスや酸化剤ガスを供給するためのガス通路を形成する機能を併せ有している。
【０００４】ところで、固体高分子型の燃料電池では、電解質膜の水分量が低下するとそのイオン導電率が低下して発電効率が低下する一方、電解質膜の水分量が過度に増大すると各反応電極におけるガスの拡散が阻害され、やはり発電効率の低下を招くこととなる。このため、こうした固体高分子型の燃料電池では、所定の発電効率を維持するうえで電解質膜の水分量を適切に管理する必要がある。例えば、還元反応により生成された水がガス通路のガスとともに下流側に移動することにより、同ガス通路の上流側に位置する電解質膜の一端側で水分量が低下するとともに、下流側に位置する電解質膜の他端側で水分量が過度に増大した場合には、発電効率の低下を招くこととなる。
【０００５】そこで従来、例えば特開平１０－３２０１１号公報にみられるように、集電板の各面に形成されるガス通路を複数の平行溝によって形成するとともに、隣り合う溝のガスの流れを対向する向きに設定したものが知られている。こうした構成によれば、集電板の各ガス通路内における平均的な水分分布がガス流れ方向において略均一になるため、電解質膜の水分量が適切に維持されるようになる。
【０００６】但し、こうした構成では、同じ面に形成された隣り合う平行溝のガスの流れを互いに対向させる必要があるため、集電板におけるガス通路の複雑化が避けきれないものとなる。そこで、集電板の一方の面に形成された燃料ガス通路の燃料ガスと、その反対側の面に形成された酸化剤ガス通路の酸化剤ガスとを互いに対向する向きに流すことが考えられる。
【０００７】こうした構成では、ガスの水分量が多くなる燃料ガス通路の下流側部分と水分量が少なくなる酸化剤ガス通路の上流側部分とが電解質膜を挟んで両側に位置するようになるとともに、水分量が少なくなる燃料ガス通路の上流側部分と水分量が多くなる酸化剤ガス通路の下流側部分とが電解質膜を挟んで両側に位置するようになる。従って、各ガス通路の構成の複雑化を招くことなく、各ガス通路のガスから電解質膜にそれぞれ供給される水分量の総和をガス流れ方向において略一定に維持することができ、同電解質膜の水分量を適量に調節することができるようになる。
【０００８】
【発明が解決しようとする課題】しかしながら、このように燃料ガス及び酸化剤ガスのガス流れを対向させるようにした場合には、各ガス通路におけるガスの流れについて以下のような不都合が生じることとなる。
【０００９】即ち、還元反応により陽極側で生成される水は酸化剤ガスとともに酸化剤ガス通路の下流側に移動する一方、陽極側から電解質膜を通じて陰極側に逆拡散した生成水は燃料ガスとともに燃料ガス通路の下流側に

移動するようになる。そして、こうした水分の移動によって、各ガス通路の下流側部分ではガスに含まれる水分の濃度が過度に上昇し、その水分が液化して各ガス通路を閉鎖してしまうことがある。その結果、各ガス通路におけるガスの流れが阻害されるようになり、発電効率の低下を招くこととなる。

【0010】この発明は、こうした従来の実情に鑑みてなされたものであり、その目的は、ガス通路の下流側部分に液化した水分による閉塞が発生するのを抑えて、良好な発電効率を維持することのできる固体高分子型燃料電池の集電板を提供することにある。

【0011】

【課題を解決するための手段】上記目的を達成するための手段及びその作用効果について以下に記載する。請求項1に記載の発明では、燃料ガス及び酸化剤ガスを対向する向きに流すための燃料ガス通路及び酸化剤ガス通路が電解質膜を挟んでその両側に設けられる固体高分子型燃料電池に用いられ、前記各ガス通路の少なくとも一方が前記電解質膜との積層面に形成される固体高分子型燃料電池の集電板において、前記ガス通路は複数の流路により構成され、それら隣り合う流路を連通する連通部が複数形成されるとともに、その連通部による連通度合いがガス流れ方向の下流側ほど大きく設定される。

【0012】上記請求項1に記載した構成によれば、ガス通路のガスに含まれる水分は同ガス通路の下流側部分ほど多くなるが、この下流側部分においては隣り合う流路を連通する連通部の連通度合いが相対的に大きく設定されているため、この連通部においてガスの拡散が促進され、同ガスに含まれる水分の液化が抑制されるようになる。

【0013】一方、ガス通路の上流側部分においては、上記連通部の連通度合いが相対的に小さく設定されているため、過剰なガスの拡散が抑制されるようになる。従って、ガス流速の低下が抑えられ、電解質膜に接触するガスの組成の均一化が図られるようになる。

【0014】その結果、上記構成によれば、ガス通路の下流側部分に液化した水分による閉塞が発生するのを抑えることができ、良好な発電効率を維持することができるようになる。

【0015】尚、上記構成のように、連通部の連通度合いをガス流れ方向の下流側ほど大きく設定するには、例えば、連通部の形成密度を下流側ほど大きく設定する、或いは、連通部の連通面積を下流側ほど大きく設定する、といった構成を採用することができる。

【0016】また、請求項1に記載した発明は、請求項2に記載されるように、前記ガス通路は上流側部分が平行溝により形成されるとともに下流側部分が格子溝により形成される、といった構成として具体化することもできる。

【0017】請求項3に記載の発明は、請求項2に記載した固体高分子型燃料電池の集電板において、前記平行溝は屈曲部分のない直線状に形成されるものであるとしている。

【0018】上記構成によれば、ガス通路の上流側部分においては、例えば同ガス通路を格子溝により構成するようにした場合と比較して、電解質膜のガスと接触する表面積が小さくなり、ガス通路を流れるガスによって電解質膜から持ち去られる水分の総量が少なくなる。更に、ガス通路の上流側部分をガスが通過する際の流動抵抗も低下するようになる。従って、電解質膜においてガス通路の上流側にそれぞれ位置する部分の水分量が過剰に低下するのを抑制して良好な発電効率を維持することができるとともに、ガスがガス通路を通過する際の圧力損失を低減することができるようになる。

【0019】請求項4に記載の発明では、請求項1乃至3のいずれかに記載の固体高分子型燃料電池の集電板において、前記ガス通路はガス流れ方向における長さL1がガス流れ方向と直交する方向における長さL2よりも長く設定されるものであるとしている。

【0020】上記構成によれば、ガス通路のガス流れ方向における長さL1をそのガス流れ方向と直交する方向における長さL2よりも長く設定することにより、ガス通路におけるガスの流速を高めることができ、電解質膜に接触するガスの組成を均一化させて良好な発電効率を確保することができるようになる。

【0021】また、請求項5に記載の発明によるように、請求項4に記載の固体高分子型燃料電池の集電板において、前記ガス流れ方向における長さL1とガス流れ方向と直交する方向における長さL2とがL1/L2>2なる関係を有して設定されるものである、といった構成を採用することにより、上記請求項4に記載した発明による作用効果を一層顕著なものとすることができる。

【0022】

【発明の実施の形態】以下、本発明の一実施形態について図1～図6を参照して説明する。図1は、本実施形態にかかる集電板10が用いられる固体高分子型燃料電池30の斜視構造を示している。

【0023】図1に示すように、燃料電池30は、交互に積層された基板20及び集電板10と、これら基板20及び集電板10からなる積層体を両側から挟む一対の側板40とを備えて構成されている。

【0024】また、図2は、図1の2-2線に沿った上記積層体の断面構造、即ち後述する各ガス通路50，60のガス流れ方向に平行で且つ基板20及び集電板10の積層方向に延びる平面に沿った断面構造を示している。

【0025】同図2に示すように、基板20は、電解質膜22と、この電解質膜22を両側から挟む反応電極（陰極23及び陽極24）と備えて構成されている。電解質膜22は、適度な湿潤状態においてイオン導電性を

示す、例えばフッ素系樹脂等の高分子材料により形成されている。また、反応電極２３，２４は、白金等の触媒を含むカーボン繊維により形成されている。

【００２６】一方、集電板１０は、カーボン等の導電材料により矩形板状に形成されている。この集電板１０は、各反応電極２３，２４を電気的に接続する機能の他、各反応電極２３，２４の表面との間に燃料ガスや酸化剤ガスを供給するためのガス通路５０，６０を形成する機能を併せ有している。

【００２７】図3は、この集電板１０において上記反応電極２３，２４のうち陰極２３と対向する一方の積層面を示している。同図に示すように、この積層面には、水素ガス等の燃料ガスを流すための燃料ガス通路５０が形成されている。また図5は、集電板１０において上記反応電極２３，２４のうち陽極２４と対向する他方の積層面を示している。同図に示すように、集電板１０において陽極２４と対向する積層面には、空気等の酸化剤ガスを流すための酸化剤ガス通路６０が形成されている。

【００２８】また、これら各図に示すように、集電板１０の一端部（図3において右端部、図5において左端部）には、燃料ガス通路５０に燃料ガスを供給するための第１の給気孔５０１及び第２の給気孔５０３が形成されるとともに、これら各給気孔５０１，５０３とそれぞれ隣接する位置には、酸化剤ガス通路６０から酸化剤ガスを排出するための第１の排気孔６０２及び第２の排気孔６０４が形成されている。

【００２９】一方、集電板１０の他端部（図3において左端部、図5において右端部）には、燃料ガス通路５０から燃料ガスを排出するための第１の排気孔５０２及び第２の排気孔５０４が形成されるとともに、これら各排気孔５０２，５０４とそれぞれ隣接する位置には、酸化剤ガス通路６０に酸化剤ガスを供給するための第１の給気孔６０１及び第２の給気孔６０３が形成されている。

【００３０】このように、燃料ガス通路５０の各給気孔５０１，５０３と酸化剤ガス通路６０の各給気孔６０１，６０３、並びに燃料ガス通路５０の各排気孔５０２，５０４と酸化剤ガス通路６０の各排気孔６０２，６０４とが、それぞれ集電板１０の反対側の端部に形成されているため、図2に矢印でそれぞれ示すように、各ガス通路５０，６０において燃料ガス及び酸化剤ガスは実質的に互いに対向して逆向きに流れるようになる。

【００３１】そして、このように各ガス通路５０，６０におけるガスの流れ方向を逆向きに設定することにより、燃料ガス及び酸化剤ガスから電解質膜２２にそれぞれ供給される水分量の総和が各ガス通路５０，６０のガス流れ方向において略一定となり、電解質膜２２の水分量が適量に維持されるようになる。

【００３２】また、集電板１０において、酸化剤ガス通路６０用の第１の排気孔６０２と燃料ガス通路５０用の第２の給気孔５０３との間には、同集電板１０の内部に形成された冷却水通路（図示略）に冷却水を供給するための給水孔７０１が形成されている。更に、酸化剤ガス通路６０用の第２の給気孔６０３と燃料ガス通路５０用の第１の排気孔５０２との間には、上記冷却水通路から冷却水を排出するための排水孔７０２が形成されている。

【００３３】一方、基板２０には、集電板１０と積層された状態において同集電板１０の各孔５０１～５０４，６０１～６０４、７０１，７０２と対応する位置に孔（図示略）がそれぞれ形成されている。集電板１０及び基板２０が積層された状態において、集電板１０のそれぞれ対応する位置に形成された孔５０１～５０４，６０１～６０４、７０１，７０２同士は、この基板２０に形成された孔を通じて連通されるようになる。

【００３４】図3に示すように、集電板１０において陰極２３と対向する積層面には、燃料ガス通路５０用の第１の給気孔５０１及び第１の排気孔５０２を繋ぐようにして凹部５０５が形成されている。また、同じく集電板１０において陰極２３と対向する積層面には、燃料ガス通路５０用の第２の給気孔５０３及び第２の排気孔５０４を繋ぐようにして別の凹部５０６が上記凹部５０５と並んで形成されている。

【００３５】これら各凹部５０５，５０６内において、各給気孔５０１，５０３寄りの位置、即ち、燃料ガス通路５０の実質的なガス流れ方向（図3において左右方向）における上流側には、そのガス流れ方向に沿って延びる断面長方形状の第１の凸部５０７が一定の間隔を隔てて複数形成されている。

【００３６】一方、各凹部５０５，５０６内において、各排気孔５０２，５０４寄りの位置、即ち、ガス流れ方向における下流側には、断面正方形状をなす第２の凸部５０８が各第１の凸部５０７と同一直線上に位置し、且つ、ガス流れ方向及び同方向と直交する方向においてそれぞれ一定の間隔を隔てて複数形成されている。

【００３７】これら第１の凸部５０７及び第２の凸部５０８はいずれも、図2に示すように、集電板１０と基板２０とが積層された状態において同基板２０の陰極２３に接触している。

【００３８】そして、各凹部５０５，５０６には、第１の凸部５０７及び第２の凸部５０８によって燃料ガスを流すための流通溝８００が形成され、これら各流通溝８００によって燃料ガス通路５０が構成されている。この燃料ガス通路５０は、ガス流れ方向における長さＬ１（図3参照）がそのガス流れ方向と直交する方向における長さＬ２（図3参照）よりも長く設定されている。詳しくは、これら各長さＬ１，Ｌ２は、Ｌ１／Ｌ２＞２なる関係が成立するように、それぞれ設定されている。

【００３９】図4に示すように、上記流通溝８００は、各第１の凸部５０７の間に形成される平行溝８０１と、各第２の凸部５０８の間に形成される格子溝８０２とに

よって構成されている。この平行溝８０１は、屈曲部分のない直線形状を有しており、ガス流れ方向において上流側に位置している。これに対して、格子溝８０２は、ガス流れ方向において下流側に位置している。

【００４０】また、各凹部５０５，５０６内には、格子溝８０２においてガス流れ方向に延びる部分と平行溝８０１とによって直線状の流路（以下、「主流路」という）５１が複数形成されている。そして、これら隣り合う主流路５１は、格子溝８０２においてガス流れ方向と直交する方向に延びる部分により形成される流路（以下、「連通路」という）５２によって互いに連通されている。格子溝８０２は各凹部５０５，５０６内においてガス流れ方向の下流側にのみ形成されているため、連通路５２はその形成密度が上流側に対して下流側のほうが大きく設定されている。即ち、この連通路５２による主流路５１の連通度合いは下流側ほど相対的に大きく設定されている。

【００４１】図５に示すように、集電板１０において陽極２４と対向する積層面には、酸化剤ガス通路６０に対応する第１の給気孔６０１及び第１の排気孔６０２を繋ぐようにして凹部６０５が形成されている。また、同じく集電板１０において陽極２４と対向する積層面には、酸化剤ガス通路６０に対応する第２の給気孔６０３及び第２の排気孔６０４を繋ぐようにして別の凹部６０６が上記凹部６０６と並んで形成されている。

【００４２】これら各凹部６０５，６０６内において、各給気孔６０１，６０３寄りの位置、即ち、酸化剤ガス通路６０の実質的なガス流れ方向（図５において左右方向）における上流側には、そのガス流れ方向に沿って延びる断面長方形状の第１の凸部６０７が一定の間隔を隔てて複数形成されている。

【００４３】一方、各凹部６０５，６０６内において、各排気孔６０２，６０４寄りの位置、即ち、ガス流れ方向における下流側には、断面正方形状をなす第２の凸部６０８が上記各第１の凸部６０７と同一直線上に位置し、且つ、ガス流れ方向及び同方向と直交する方向においてそれぞれ一定の間隔を隔てて複数形成されている。

【００４４】これら第１の凸部６０７及び第２の凸部６０８はいずれも、図２に示すように、集電板１０と基板２０とが積層された状態において同基板２０の陽極２４に接触している。

【００４５】そして、各凹部６０５，６０６には、第１の凸部６０７及び第２の凸部６０８によって酸化剤ガスを流すための流通溝９００が形成されている。この流通溝９００は、ガスの流れと直交する方向に延びる集電板１０の中心軸Ｃ（図５参照）回りに上記燃料ガス通路５０を構成する流通溝８００と対称的な同一の形状を有している。

【００４６】また、各流通溝９００によって酸化剤ガス通路６０が構成されている。この酸化剤ガス通路６０は、上記燃料ガス通路５０と同様に、ガス流れ方向における長さＬ１（図５参照）がそのガス流れ方向と直交する方向における長さＬ２（図５参照）の２倍（Ｌ２×２）よりも長く設定されている。詳しくは、これら各長さＬ１，Ｌ２は、Ｌ１／Ｌ２＞２なる関係が成立するように、それぞれ設定されている。このように集電板１０の各ガス通路５０，６０の長さＬ１，Ｌ２を上記関係を有して設定することにより、燃料電池３０の形状を扁平形状にすることができ、同燃料電池３０を例えば車両の床下等、狭い空間に搭載することも可能になる。

【００４７】図６に示すように、上記流通溝９００は、各第１の凸部６０７の間に形成される平行溝９０１と、各第２の凸部６０８の間に形成される格子溝９０２とによって構成されている。この平行溝９０１は、屈曲部分のない直線形状を有しており、ガス流れ方向において上流側に位置している。これに対して、格子溝９０２は、ガス流れ方向において下流側に位置している。

【００４８】また、各凹部６０５，６０６内には、格子溝９０２においてガス流れ方向に延びる部分と平行溝９０１とによって直線状の流路（以下、「主流路」という）６１が複数形成されている。そして、これら隣り合う主流路６１は、格子溝９０２においてガス流れ方向と直交する方向に延びる部分により形成される流路（以下、「連通路」という）６２によって互いに連通されている。格子溝９０２は各凹部６０５，６０６内においてガス流れ方向の下流側にのみ形成されているため、連通路６２はその形成密度が上流側に対して下流側のほうが大きく設定されている。即ち、この連通路６２による主流路６１の連通度合いは下流側ほど相対的に大きく設定されている。

【００４９】次に、上記のようにして構成された集電板１０において、各ガス通路５０，６０内における燃料ガス及び酸化剤ガスの流れについて説明する。燃料ガスは、燃料ガス通路５０用の各給気孔５０１，５０３を通じて各凹部５０５，５０６内に導入された後、各平行溝８０１を通過して下流側に流れるようになる。また、酸化剤ガスについても同様に、酸化剤ガス通路６０用の各給気孔６０１，６０３を通じて各凹部６０５，６０６内に導入された後、各平行溝９０１を通過して下流側に流れるようになる。

【００５０】このようにして、各平行溝８０１をその下流側に移動した燃料ガスは、更に格子溝８０２を通過した後、各排気孔５０２，５０４を通じて排出される。酸化剤ガスについても同様に、各平行溝８０１から格子溝９０２を通過した後、各排気孔６０２，６０４を通じて排出される。

【００５１】従って、図４に矢印Ａで示すように、燃料ガス通路５０の主流路５１には、各給気孔５０１，５０３から各排気孔５０２，５０４に向かう燃料ガスの実質的な流れが形成されるようになり、また図６に矢印Ａで

示すように、酸化剤ガス通路６０の主流路６１には、各給気孔６０１，６０３から各排気孔６０２，６０４に向かう酸化剤ガスの実質的な流れが形成されるようになる。

【００５２】また、こうした各主流路５１，６１における実質的なガスの流れに加えて、各ガス通路５０，６０には隣り合う主流路５１，６１を連通する連通路５２，６２が形成されているため、図４及び図６に矢印Ｂで示すように、ガスの一部はこの連通路５２，６２を通じてガスの実質的な流れ方向と直交する方向に拡散するようになる。

【００５３】この連通路５２，６２は、その連通度合いが下流側ほど相対的に大きく設定されていため、各ガス通路５０，６０の下流側部分では、この連通路５２，６２においてガスの拡散がより促進されるようになり、同ガスに含まれる水分の液化が抑制されることとなる。一方、各ガス通路５０，６０の上流側部分においては、連通路５２，６２の連通度合いが相対的に小さく設定されているため、過剰な拡散が抑制されるようになる。従って、ガス流速の低下が抑えられ、各反応電極に接触するガスの組成の均一化が図られるようになる。

【００５４】その結果、各ガス通路５０，６０の下流側部分に液化した水分による閉塞が発生するのが抑制され、良好な発電効率が維持されるようになる。更に、各ガス通路５０，６０の上流側部分は、屈曲部分のない直線状の平行溝８０１，９０１によって形成されているため、例えば格子溝等と比較して、電解質膜２２のガスと接触する表面積が小さくなり、各ガス通路５０，６０を流れるガスによって電解質膜２２から持ち去られる水分の総量が少なくなる。更に、各ガス通路５０，６０の上流側部分をガスが通過する際の流動抵抗も低下するようになる。

【００５５】その結果、電解質膜２２において各ガス通路５０，６０の上流側に位置する部分の水分量が過剰に低下することが抑えられて良好な発電効率が維持されるとともに、ガスが各ガス通路５０，６０を通過する際の圧力損失の低減が図られるようになる。

【００５６】また、各ガス通路５０，６０は、ガス流れ方向における長さＬ１がガス流れ方向と直交する方向における長さＬ２よりも長く設定されているため、各ガス通路５０，６０におけるガスの流速が高められ、各反応電極２３，２４に接触するガスの組成が均一化して良好な発電効率が確保されるようになる。

【００５７】特に、こうした発電効率の向上は、各ガス通路５０，６０のガス流れ方向における長さＬ１と、そのガス流れ方向と直交する方向における長さＬ２とを、Ｌ１／Ｌ２＞２なる関係を有して設定することで一層顕著になることが発明者による実験によって確認されている。

【００５８】以上説明したように、本実施形態によれば以下の作用効果が得られるようになる。

（１）各ガス通路５０，６０の隣り合う主流路５１，６１を連通する連通路５２，６２を形成するとともに、その連通路５２，６２による主流路５１，６１の連通度合いを下流側ほど相対的に大きく設定するようにしたことで、各ガス通路５０，６０の下流側部分に液化した水分による閉塞が発生するのを抑えることができ、良好な発電効率を維持することができるようになる。

【００５９】（２）各ガス通路５０，６０の上流側部分を屈曲部分のない直線状の平行溝８０１，９０１によって形成するようにしたことで、電解質膜２２において各ガス通路５０，６０の上流側に位置する部分の水分量が過剰に低下するのを抑制して良好な発電効率を維持することができるとともに、ガスが各ガス通路５０，６０を通過する際の圧力損失を低減することができるようになる。

【００６０】（３）各ガス通路５０，６０のガス流れ方向における長さＬ１を同ガス流れ方向と直交する方向における長さＬ２よりも長く設定するようにしたことで、各反応電極２３，２４に接触するガスの組成を均一化させて良好な発電効率を確保することができるようになる。

【００６１】（４）特に、各ガス通路５０，６０の各長さＬ１，Ｌ２を、Ｌ１／Ｌ２＞２なる関係を有して設定するようにしたことで、上記（３）の作用効果を一層顕著なものとすることができる。

【００６２】（５）加えて、燃料ガス通路５０を構成する流通溝８００と酸化剤ガス通路６０を構成する流通溝９００とを、ガス流れ方向と直交する方向に延びる集電板１０の中心軸Ｃ回りにおいて対称的な同一形状としたため、集電板１０と基板２０とを積層する際に、同集電板１０において燃料ガス通路５０の形成された面と酸化剤ガス通路６０の形成された面とを判別する作業が不要になる。従って、集電板１０及び基板２０を積層する際の作業性を向上させることができるようになる。

【００６３】尚、以上説明した実施形態にかかる集電板は以下のように構成を変更することもできる。

・図７或いは図８に示すように、集電板１０において陰極２３に対向する積層面の各凹部５０５，５０６内に、ガス流れ方向における長さが下流側ほど短くなるように設定された複数の凸部５０９を形成し、これら凸部５０９の間に形成される流通溝８０３によって燃料ガス通路５０を構成する。また、集電板１０において陽極２４に対向する積層面の各凹部６０５，６０６内にも同様に、ガス流れ方向における長さが下流側ほど短くなるように設定された複数の凸部（図示略）を形成し、これら凸部の間に形成される流通溝（図示略）によって酸化剤ガス通路６０を構成する。

【００６４】こうした構成によっても、各ガス通路５０，６０の連通度合いを下流側ほど相対的に大きく設定

することができ、上記実施形態と同等の作用効果を得ることはできる。

【００６５】特に、図８に示すように、各ガス通路５０，６０（同図には燃料ガス通路５０のみ示す）の連通部分の位置をガス流れ方向においてずらすことでガスの拡散を更に促進させることができ、同ガスに含まれる水分の液化を抑制することができるようになる。

【００６６】・上記実施形態では、第２の凸部５０８，６０８をガス流れ方向において一定の間隔を隔てて配設するようにしたが、この第２の凸部５０８，６０８が配設される間隔をガス流れ方向の下流側ほど拡大して上記連通路５２，６２の連通面積を下流側ほど大きくすることにより、各ガス通路５０，６０の連通度合いを同ガス流れ方向の下流側ほど大きく設定するようにしてもよい。

【００６７】・上記実施形態では、各ガス通路５０，６０用の給気孔５０１，５０３，６０１，６０３と排気孔５０２，５０４，６０２，６０４とを集電板１０にそれぞれ２個ずつ設け、各ガス通路５０，６０をそれぞれ２つの独立した通路によって構成するようにしたが、各ガス通路５０，６０をそれぞれ単一の通路によっ構成するようにしてもよい。

【００６８】・上記実施形態では、第１の凸部５０７，６０７を断面長方形状に、第２の凸部５０８，６０８を断面正方形状としたが、これら凸部５０７，６０７，５０８，６０８はこうした断面形状を有するもの限られず、例えば、第１の凸部５０７，６０７を断面楕円形状に、第２の凸部５０８，６０８を断面真円形状とするようにしてもよい。

【００６９】・上記実施形態では、燃料ガス通路及び酸化剤ガス通路の双方が形成される集電板の例を示したが、同集電板はこれら各ガス通路のうち一方のみが形成されるものであってもよい。

【図面の簡単な説明】

【図１】燃料電池の積層構造を示す斜視図。

【図２】図１の２－２線に沿った部分断面図。

【図３】陰極と対向する集電板の積層面に形成された燃料ガス通路を示す平面図。

【図４】燃料ガス通路を構成する流通溝を拡大して示す拡大平面図。

【図５】陽極と対向する集電板の積層面に形成された酸化剤ガス通路を示す平面図。

【図６】酸化剤ガス通路を構成する流通溝を拡大して示す拡大平面図。

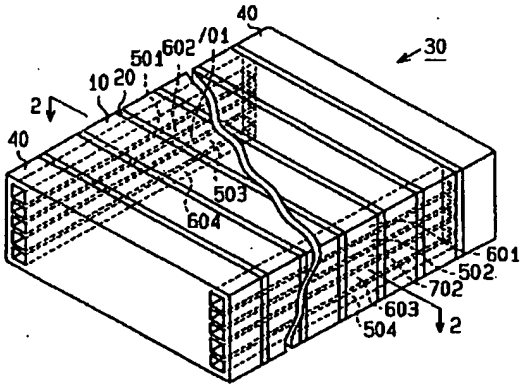
【図７】ガス通路の構成変形例を示す平面図。

【図８】ガス通路の構成変形例を示す平面図。

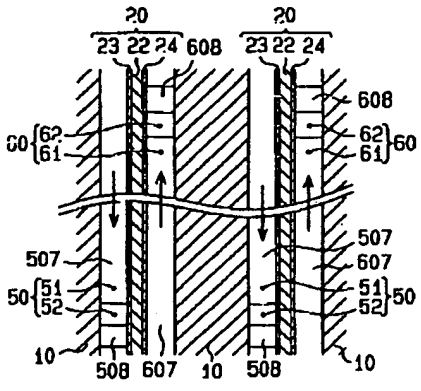
【符号の説明】

１０…集電板、２０…基板、２２…電解質膜、２３…陰極、２４…陽極、３０…固体高分子型燃料電池、５０…燃料ガス通路、５１…主流路、５２…連通路、６０…酸化剤ガス通路、６１…主流路、６２…連通路、５０１…第１の給気孔、５０２…第１の排気孔、５０３…第２の給気孔、５０４…第２の排気孔、５０５，５０６…凹部、５０７…第１の凸部、５０８…第２の凸部、５０９…凸部、６０１…第１の給気孔、６０２…第１の排気孔、６０３…第２の給気孔、６０４…第２の排気孔、６０５，６０６…凹部、６０７…第１の凸部、６０８…第２の凸部、７０１…給水孔、７０２…排水孔、８００…流通溝、８０１…平行溝、８０２…格子溝、８０３…流通溝、９００…流通溝、９０１…平行溝、９０２…格子溝。

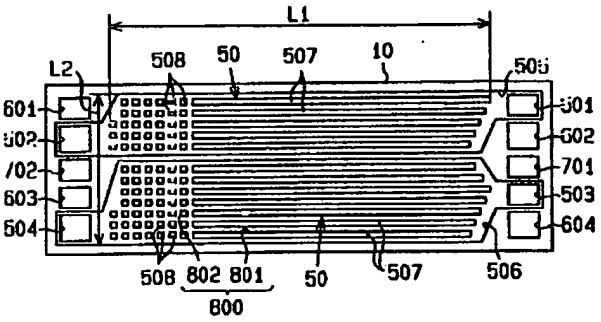
【図１】



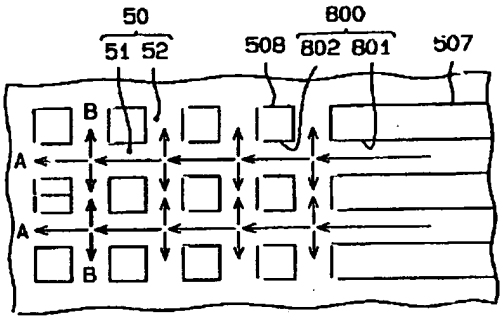
【図２】



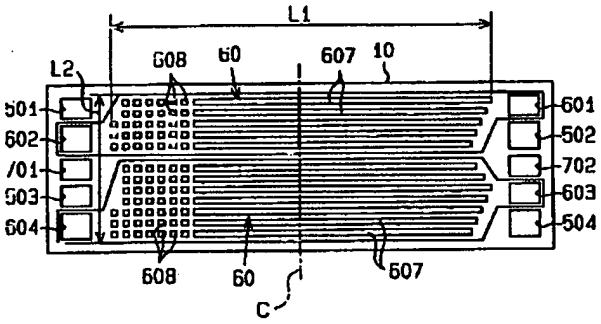
【図3】



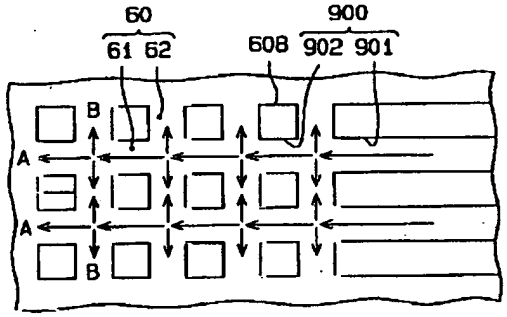
【図4】



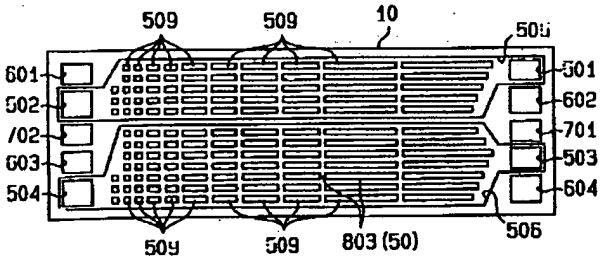
【図5】



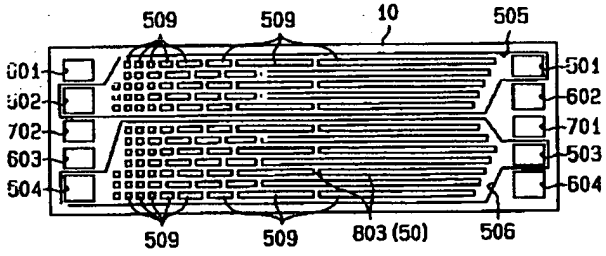
【図6】



【図7】



【図8】



* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]It is used for a polymer electrolyte fuel cell with which a fuel gas passage and an oxidant gas passage for passing fuel gas and oxidant gas to direction which counters are established in the both sides on both sides of an electrolyte membrane, In a collecting electrode plate of a polymer electrolyte fuel cell with which at least one side of each of said gas passageway is formed in a lamination side with said electrolyte membrane, A collecting electrode plate of a polymer electrolyte fuel cell while two or more communicating parts which said gas passageway is constituted by two or more channels, and open these next door **** channel for free passage are formed, wherein a communicated degree by the communicating part is more greatly set up by the downstream of a gas flow direction.
[Claim 2]A collecting electrode plate of the polymer electrolyte fuel cell according to claim 1 with which a downstream portion is formed of a grating groove while an upstream portion is formed of a parallel groove as for said gas passageway.
[Claim 3]A collecting electrode plate of the polymer electrolyte fuel cell according to claim 2 formed in linear shape in which said parallel groove does not have a crooked part.
[Claim 4]A collecting electrode plate of the polymer electrolyte fuel cell according to any one of claims 1 to 3 set up for a long time than the length L2 in a direction to which a gas flow direction and the length [in / in said gas passageway / a gas flow direction] L1 cross at right angles.
[Claim 5]A collecting electrode plate of the polymer electrolyte fuel cell according to claim 4 with which the length L2 in a direction which intersects perpendicularly with the length L1 and a gas flow direction in said gas flow direction is set up by having a relation which becomes L1/L2>2.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the collecting electrode plate of the polymer electrolyte fuel cell with which either [at least] a fuel gas passage or an oxidant gas passage is formed in a lamination side with an electrolyte membrane.
[0002]
[Description of the Prior Art]One cell (unit cell) is constituted from the solid polymer type fuel cell by the electrolyte membrane which consists of solid polymer material, and the reaction electrodes (anode and negative pole) provided as sandwiched this electrolyte membrane from both sides. And while contacting the fuel gas which contains hydrogen in the negative pole, the oxidant gas which contains oxygen in the anode is contacted, He is trying to take out the electrical energy produced when the hydrogen ion which passes an electrolyte membrane from the negative pole and moves to the anode, and oxygen of the anode carry out a reduction reaction and water is generated from each reaction electrodes.
[0003]Since the electromotive force which can be taken out only by one unit cell has a limitation, he is trying to usually acquire desired electromotive force with a solid polymer type fuel cell by carrying out the plural laminates of the member called each unit cell and a collecting electrode plate by turns. This collecting electrode plate is formed with electrical conducting materials, such as carbon, and combines and has a function which forms the gas passageway for supplying fuel gas and oxidant gas between the surfaces of each reaction electrodes besides [which electrically connects each reaction electrodes] a function.
[0004]By the way, in a solid polymer type fuel cell, if the moisture content of an electrolyte membrane falls, while the ionic conductivity will fall and generation efficiency will fall, when the moisture content of an electrolyte membrane increases too much, diffusion of the gas in each reaction electrodes will be checked, and decline in generation efficiency will be caused too. For this reason, in a such solid polymer type fuel cell, when maintaining predetermined generation efficiency, it is necessary to manage the moisture content of an electrolyte membrane appropriately. For example, while a moisture content falls by the end side of the electrolyte membrane located in the upstream of the gas passageway when the water generated by the reduction reaction moves to the downstream with the gas of a gas passageway, When a moisture content increases too much by the other end side of the electrolyte membrane located in the downstream, decline in generation efficiency will be caused.
[0005]Then, while forming the gas passageway formed in each field of a collecting electrode plate by two or more parallel grooves so that the former, for example, JP,10-32011,A, may see, what set the flow of the gas of an adjacent slot as the direction which counters is known. According to such composition, since the average moisture distribution in each gas passageway of a collecting electrode plate becomes abbreviated homogeneity in a gas flow direction, the moisture content of an electrolyte membrane comes to be maintained appropriately.
[0006]However, since it is necessary to make the flow of the gas of the adjacent parallel groove formed in the same field counter mutually, avoiding complication of the gas passageway in a collecting

electrode plate in such composition, cannot be finished. Then, it is possible to pass the fuel gas of the fuel gas passage formed in one field of a collecting electrode plate, and the oxidant gas of the oxidant gas passage formed in the field of the opposite hand to the direction which counters mutually.
[0007]While the downstream portion of the fuel gas passage where the moisture content of gas increases, and the upstream portion of the oxidant gas passage whose moisture content decreases come to be located in both sides on both sides of an electrolyte membrane in such composition, The upstream portion of the fuel gas passage whose moisture content decreases, and the downstream portion of the oxidant gas passage where a moisture content increases come to be located in both sides on both sides of an electrolyte membrane. Therefore, without causing complication of the composition of each gas passageway, total of the moisture content supplied to an electrolyte membrane from the gas of each gas passageway, respectively can be maintained to approximately regulated in a gas flow direction, and the moisture content of the electrolyte membrane can be adjusted in optimum dose.
[0008]
[Problem(s) to be Solved by the Invention]However, when it is made to make the gas flow of fuel gas and oxidant gas counter in this way, the following inconvenience will arise about the gas in each gas passageway flowing.
[0009]That is, while the water generated by the reduction reaction by the anode side moves to the downstream of an oxidant gas passage with oxidant gas, the produced water which carried out back-diffusion of gas to the negative pole side through the electrolyte membrane from the anode side comes to move to the downstream of a fuel gas passage with fuel gas. And by movement of such moisture, by the downstream portion of each gas passageway, the concentration of the moisture contained in gas may rise too much, the moisture may liquefy, and each gas passageway may be closed. As a result, the flow of the gas in each gas passageway will come to be checked, and decline in generation efficiency will be caused.
[0010]this invention is made in view of such the conventional actual condition, and comes out. It is in the purpose suppressing that the blockade by the moisture liquefied to the downstream portion of ** occurs, and providing the collecting electrode plate of the polymer electrolyte fuel cell which can maintain good generation efficiency.

[0011]
[Means for Solving the Problem]A means for attaining the above-mentioned purpose and its operation effect are indicated below. It is used for a polymer electrolyte fuel cell with which a fuel gas passage and an oxidant gas passage for passing fuel gas and oxidant gas in the invention according to claim 1 to direction which counters are established in the both sides on both sides of an electrolyte membrane, In a collecting electrode plate of a polymer electrolyte fuel cell with which at least one side of each of said gas passageway is formed in a lamination side with said electrolyte membrane, Said gas passageway is constituted by two or more channels, and while two or more communicating parts which open these next door **** channel for free passage are formed, a communicated degree by the communicating part is more greatly set up by the downstream of a gas flow direction.
[0012]According to composition indicated to above-mentioned claim 1, moisture contained in gas of a gas passageway increases like a downstream portion of the gas passageway, but. Since a communicated degree of a communicating part which opens for free passage a channel which adjoins each other in this downstream portion is set up greatly relatively, diffusion of gas is promoted in this communicating part, and liquefaction of moisture contained in the gas comes to be controlled.
[0013]On the other hand, in an upstream portion of a gas passageway, since a communicated degree of the above-mentioned communicating part is set up small relatively, diffusion of superfluous gas comes to be controlled. Therefore, a fall of a gas flow rate is suppressed and equalization of a presentation of gas in contact with an electrolyte membrane comes to be attained.
[0014]As a result, according to the above-mentioned composition, it can suppress that a blockade by moisture liquefied to a downstream portion of a gas passageway occurs, and good generation efficiency can be maintained now.

[0015]Like the above-mentioned composition, in order for the downstream of a gas flow direction to set up a communicated degree of a communicating part more greatly, the downstream sets up formation density of a communicating part more greatly, or composition that the downstream sets up free passage area of a communicating part more greatly can be adopted, for example.
[0016]Said gas passageway can also be materialized as composition that a downstream portion is formed of a grating groove while an upstream portion is formed of a parallel groove so that an invention indicated to claim 1 may be indicated to claim 2.
[0017]In a collecting electrode plate of a polymer electrolyte fuel cell which the invention according to claim 3 indicated to claim 2, said parallel groove supposes that it is what is formed in linear shape without a crooked part.
[0018]According to the above-mentioned composition, in an upstream portion of a gas passageway, as compared with a case where a grating groove constitutes the gas passageway, for example, surface area in contact with gas of an electrolyte membrane becomes small, and a total amount of moisture away held from an electrolyte membrane by gas which flows through a gas passageway decreases. Flow resistance at the time of gas passing an upstream portion of a gas passageway also comes to fall. Therefore, while being able to control that a moisture content of a portion located in the upstream of a gas passageway in an electrolyte membrane, respectively falls superfluously and being able to maintain good generation efficiency, pressure loss at the time of gas passing a gas passageway can be reduced.
[0019]In the invention according to claim 4, said gas passageway supposes that the length L1 in a gas flow direction is what is set up for a long time than the length L2 in a direction which intersects perpendicularly with a gas flow direction in a collecting electrode plate of the polymer electrolyte fuel cell according to any one of claims 1 to 3.
[0020]By setting up the length L1 in a gas flow direction of a gas passageway for a long time than the length L2 in a direction which intersects perpendicularly with the gas flow direction according to the above-mentioned composition, Can raise the rate of flow of gas in a gas passageway, a presentation of gas in contact with an electrolyte membrane can be made to equalize, and good generation efficiency can be secured now.
[0021]In [so that according to the invention according to claim 5] a collecting electrode plate of the polymer electrolyte fuel cell according to claim 4, By adopting composition that the length L2 in a direction which intersects perpendicularly with the length L1 and a gas flow direction in said gas flow direction is what has a becoming relation and is set up L1/L2>2, a operation effect by invention indicated to above-mentioned claim 4 can be made much more remarkable.
[0022]
[Embodiment of the Invention]Hereafter, one embodiment of this invention is described with reference to drawing 1 - drawing 6. Drawing 1 shows the strabism structure of the polymer electrolyte fuel cell 30 where the collecting electrode plate 10 concerning this embodiment is used.
[0023]As shown in drawing 1, the fuel cell 30 is provided with the substrate 20 and the collecting electrode plate 10 which were laminated by turns, and the side plate 40 of the couple which sandwiches the layered product which consists of these substrates 20 and the collecting electrode plate 10 from both sides, and is constituted.
[0024]Drawing 2 is parallel to the section structure of the above-mentioned layered product which met two to 2 line of drawing 1, i.e., the gas flow direction of each gas passagewaies 50 and 60 mentioned later, and shows the section structure along the flat surface which extends in the laminating direction of the substrate 20 and the collecting electrode plate 10.
[0025]As shown in the drawing 2, it has the substrate 20 with the reaction electrodes (the negative pole 23 and anode 24) which sandwich the electrolyte membrane 22 and this electrolyte membrane 22 from both sides, and it is constituted. In the moderate damp or wet condition, the electrolyte membrane 22 shows ion conductivity, for example, is formed with polymer materials, such as fluororesin. The reaction electrodes 23 and 24 are formed of carbon fiber including the catalyst of platinum etc.
[0026]On the other hand, the collecting electrode plate 10 is formed in rectangular plate shape with electrical conducting materials, such as carbon. This collecting electrode plate 10 combines and has a

function which forms the gas passagewaies 50 and 60 for supplying fuel gas and oxidant gas between the surfaces of each reaction electrodes 23 and 24 besides [which electrically connects each reaction electrodes 23 and 24] a function.

[0027]In this collecting electrode plate 10, while counters with the negative pole 23 among the above-mentioned reaction electrodes 23 and 24, and drawing 3 shows the lamination side. As shown in the figure, the fuel gas passage 50 for passing fuel gas, such as hydrogen gas, is formed in this lamination side. Drawing 5 shows the lamination side of the anode 24 and another side which counters among the above-mentioned reaction electrodes 23 and 24 in the collecting electrode plate 10. As shown in the figure, in the collecting electrode plate 10, the oxidant gas passage 60 for passing oxidant gas, such as air, is formed in the anode 24 and the lamination side which counters.

[0028]As shown in these each figure, in the end part (it is [in / on drawing 3 and / a right end section and drawing 5] a left edge part) of the collecting electrode plate 10. While the 1st air supplying opening 501 and 2nd air supplying opening 503 for supplying fuel gas to the fuel gas passage 50 are formed, in the position which adjoins these each air supplying opening 501,503, respectively. The 1st exhaust hole 602 and 2nd exhaust hole 604 for discharging oxidant gas from the oxidant gas passage 60 are formed.

[0029]On the other hand, to the other end (it is [in / on drawing 3 and / a left edge part and drawing 5] a right end section) of the collecting electrode plate 10. While the 1st exhaust hole 502 and 2nd exhaust hole 504 for discharging fuel gas from the fuel gas passage 50 are formed, in the position which adjoins these each exhaust hole 502,504, respectively. The 1st air supplying opening 601 and 2nd air supplying opening 603 for supplying oxidant gas to the oxidant gas passage 60 are formed.

[0030]Thus, each air supplying opening 501,503 of the fuel gas passage 50, each air supplying opening 601,603 of the oxidant gas passage 60, and each exhaust hole 502,504 of the fuel gas passage 50 and each exhaust hole 602,604 of the oxidant gas passage 60, Since it is formed in the end of the opposite hand of the collecting electrode plate 10, respectively, as an arrow shows to drawing 2, respectively, in each gas passagewaies 50 and 60, fuel gas and oxidant gas counter mutually substantially, and come to flow for reverse.

[0031]And by setting up the flow direction of the gas in each gas passagewaies 50 and 60 for reverse in this way, Total of the moisture content supplied to the electrolyte membrane 22, respectively serves as approximately regulated from fuel gas and oxidant gas in the gas flow direction of each gas passagewaies 50 and 60, and the moisture content of the electrolyte membrane 22 comes to be maintained by optimum dose.

[0032]In the collecting electrode plate 10, the water supply hole 701 for supplying cooling water to the cooling water passage (graphic display abbreviation) formed in the inside of the collecting electrode plate 10 is formed between the 1st exhaust hole 602 for oxidant gas passage 60, and the 2nd air supplying opening 503 for fuel gas passage 50. Between the 2nd air supplying opening 603 for oxidant gas passage 60, and the 1st exhaust hole 502 for fuel gas passage 50, the drain hole 702 for discharging cooling water from the above-mentioned cooling water passage is formed.

[0033]On the other hand, in the state where the substrate 20 laminated with the collecting electrode plate 10, the hole (graphic display abbreviation) is formed in each holes 501-504,601-604, and 701,702 of the collecting electrode plate 10, and a corresponding position, respectively. In the state where the collecting electrode plate 10 and the substrate 20 were laminated, the holes 501-504,601-604 and 701,702 comrades which were formed in the position to which the collecting electrode plate 10 corresponds, respectively come to be opened for free passage through the hole formed in this substrate 20.

[0034]As shown in drawing 3, as the 1st air supplying opening 501 and 1st exhaust hole 502 for fuel gas passage 50 are connected with the negative pole 23 and the lamination side which counters, the crevice 505 is formed in it in the collecting electrode plate 10. Similarly, in the collecting electrode plate 10, as the 2nd air supplying opening 503 and 2nd exhaust hole 504 for fuel gas passage 50 are connected with the negative pole 23 and the lamination side which counters, another crevice 506 is formed in it along with the above-mentioned crevice 505.

[0035][in these each crevice 505,506] to the upstream in the position of each air supplying opening 501,503 slippage, i.e., the substantial gas flow direction of the fuel gas passage 50, (in drawing 3, it is a

longitudinal direction). The 1st heights 507 of the rectangular shape in section prolonged along the gas flow direction separate a fixed interval, and are formed. [two or more]
[0036]On the other hand, [in each crevice 505,506], in the position of each exhaust hole 502,504 slippage, i.e., the downstream in a gas flow direction. The 2nd heights 508 that make the shape of a section square are located on the same straight line as each 1st heights 507, and a respectively fixed interval is separated in a gas flow direction and the direction, and the direction that intersects perpendicularly, and more than one are formed.
[0037]All, in the state where the collecting electrode plate 10 and the substrate 20 were laminated, these 1st heights 507 and the 2nd heights 508 touch the negative pole 23 of the substrate 20, as shown in drawing 2.
[0038]And the circulating groove 800 for passing fuel gas by the 1st heights 507 and 2nd heights 508 is formed in each crevice 505,506, and the fuel gas passage 50 is constituted by these each circulating groove 800. This fuel gas passage 50 is set up for a long time than the length L2 (refer to drawing 3) in the direction to which that gas flow direction and the length L1 (refer to drawing 3) in a gas flow direction cross at right angles. In detail, these each length L1 and L2 are set up, respectively so that the relation which becomes L1/L2>2 may be materialized.
[0039]As shown in drawing 4, the above-mentioned circulating groove 800 is constituted by the parallel groove 801 formed between each 1st heights 507, and the grating groove 802 formed between each 2nd heights 508. This parallel groove 801 has linear shape without a crooked part, and is located in the upstream in a gas flow direction. On the other hand, the grating groove 802 is located in the downstream in a gas flow direction.
[0040]In each crevice 505,506, two or more linear shape channels (henceforth a "mainstream way") 51 are formed of the portion and the parallel groove 801 which extend in a gas flow direction in the grating groove 802. And the these next door **** mainstream way 51 is mutually opened for free passage by the channel (henceforth a "communicating path") 52 formed of the portion prolonged in the direction which intersects perpendicularly with a gas flow direction in the grating groove 802. Since the grating groove 802 is formed in each crevice 505,506 only at the downstream of the gas flow direction, as for the communicating path 52, the way of the downstream is greatly set up for the formation density to the upstream. That is, the communicated degree of the mainstream way 51 by this communicating path 52 is relatively set up greatly like the downstream.
[0041]As shown in drawing 5, as the 1st air supplying opening 601 and 1st exhaust hole 602 corresponding to the oxidant gas passage 60 are connected with the anode 24 and the lamination side which counters, the crevice 605 is formed in it in the collecting electrode plate 10. Similarly, in the collecting electrode plate 10, as the 2nd air supplying opening 603 and 2nd exhaust hole 604 corresponding to the oxidant gas passage 60 are connected with the anode 24 and the lamination side which counters, another crevice 606 is formed in it along with the above-mentioned crevice 606.
[0042][in these each crevice 605,606] to the upstream in the position of each air supplying opening 601,603 slippage, i.e., the substantial gas flow direction of the oxidant gas passage 60, (in drawing 5, it is a longitudinal direction). The 1st heights 607 of the rectangular shape in section prolonged along the gas flow direction separate a fixed interval, and are formed. [two or more]
[0043]On the other hand, [in each crevice 605,606], in the position of each exhaust hole 602,604 slippage, i.e., the downstream in a gas flow direction. The 2nd heights 608 that make the shape of a section square are located on the same straight line as each 1st heights 607 of the above, and a respectively fixed interval is separated in a gas flow direction and the direction, and the direction that intersects perpendicularly, and more than one are formed.
[0044]All, in the state where the collecting electrode plate 10 and the substrate 20 were laminated, these 1st heights 607 and the 2nd heights 608 touch the anode 24 of the substrate 20, as shown in drawing 2.
[0045]And the circulating groove 900 for passing oxidant gas by the 1st heights 607 and 2nd heights 608 is formed in each crevice 605,606. This circulating groove 900 has the circulating groove 800 which constitutes the above-mentioned fuel gas passage 50 in the circumference of the medial axis C of the collecting electrode plate 10 prolonged in the direction which intersects perpendicularly with the flow of

gas (refer to drawing 5), and the same symmetrical shape.
[0046]The oxidant gas passage 60 is constituted by each circulating groove 900. In this oxidant gas passage 60, the length L2 (refer to drawing 5) in the direction to which that gas flow direction and the length L1 (refer to drawing 5) in a gas flow direction cross at right angles is set up like the above-mentioned fuel gas passage 50 for a long time than twice (L2x2). In detail, these each length L1 and L2 are set up, respectively so that the relation which becomes L1/L2>2 may be materialized. Thus, by having the above-mentioned relation and setting up the length L1 of each gas passagewaies 50 and 60 of the collecting electrode plate 10, and L2, shape of the fuel cell 30 can be made into flat shape, and it also becomes possible to carry the fuel cell 30 in narrow space, such as an under floor of vehicles.
[0047]As shown in drawing 6, the above-mentioned circulating groove 900 is constituted by the parallel groove 901 formed between each 1st heights 607, and the grating groove 902 formed between each 2nd heights 608. This parallel groove 901 has linear shape without a crooked part, and is located in the upstream in a gas flow direction. On the other hand, the grating groove 902 is located in the downstream in a gas flow direction.
[0048]In each crevice 605,606, two or more linear shape channels (henceforth a "mainstream way") 61 are formed of the portion and the parallel groove 901 which extend in a gas flow direction in the grating groove 902. And the these next door **** mainstream way 61 is mutually opened for free passage by the channel (henceforth a "communicating path") 62 formed of the portion prolonged in the direction which intersects perpendicularly with a gas flow direction in the grating groove 902. Since the grating groove 902 is formed in each crevice 605,606 only at the downstream of the gas flow direction, as for the communicating path 62, the way of the downstream is greatly set up for the formation density to the upstream. That is, the communicated degree of the mainstream way 61 by this communicating path 62 is relatively set up greatly like the downstream.
[0049]Next, in the collecting electrode plate 10 constituted as mentioned above, it explains that the fuel gas in each gas passageway 50 and 60 and oxidant gas flow. After fuel gas is introduced in each crevice 505,506 through each air supplying opening 501,503 for fuel gas passage 50, it passes through each parallel groove 801, and comes to flow into the downstream. After being similarly introduced in each crevice 605,606 through each air supplying opening 601,603 for oxidant gas passage 60 about oxidant gas, it passes through each parallel groove 901, and comes to flow into the downstream.
[0050]Thus, the fuel gas which moved each parallel groove 801 to the downstream is discharged through each exhaust hole 502,504, after passing the grating groove 802 further. After passing the grating groove 902 from each parallel groove 801 similarly about oxidant gas, it is discharged through each exhaust hole 602,604.
[0051]Therefore, as the arrow A shows to drawing 4, in the mainstream way 51 of the fuel gas passage 50. As the substantial flow of the fuel gas which goes to each exhaust hole 502,504 from each air supplying opening 501,503 comes to be formed and the arrow A shows to drawing 6, The substantial flow of the oxidant gas which goes to each exhaust hole 602,604 from each air supplying opening 601,603 comes to be formed in the mainstream way 61 of the oxidant gas passage 60.
[0052]With the flow of the substantial gas in each such mainstream ways 51 and 61, in addition, since the communicating paths 52 and 62 which open the adjacent mainstream ways 51 and 61 for free passage are formed in each gas passagewaies 50 and 60, As the arrow B shows to drawing 4 and drawing 6, it comes to diffuse a part of gas in the direction which intersects perpendicularly with the substantial flow direction of gas through these communicating paths 52 and 62.
[0053]That communicated degree is relatively set up for the downstream greatly, these communicating paths 52 and 62 are hurt, in the downstream portion of each gas passagewaies 50 and 60, in these communicating paths 52 and 62, diffusion of gas will come to be promoted more, and liquefaction of the moisture contained in the gas will be controlled. On the other hand, in the upstream portion of each gas passagewaies 50 and 60, since the communicated degree of the communicating paths 52 and 62 is set up small relatively, superfluous diffusion comes to be controlled. Therefore, the fall of a gas flow rate is suppressed and equalization of a presentation of gas in contact with each reaction electrodes comes to be attained.

[0054]As a result, it is controlled that the blockade by the moisture liquefied to the downstream portion of each gas passagewaies 50 and 60 occurs, and good generation efficiency comes to be maintained. The upstream portion of each gas passagewaies 50 and 60, Since it is formed of the linear shape parallel groove 801,901 without a crooked part, for example as compared with a grating groove etc., the surface area in contact with the gas of the electrolyte membrane 22 becomes small, and the total amount of the moisture away held from the electrolyte membrane 22 by the gas which flows through each gas passagewaies 50 and 60 decreases. The flow resistance at the time of gas passing the upstream portion of each gas passagewaies 50 and 60 also comes to fall.
[0055]As a result, while it is suppressed that the moisture content of the portion located in the upstream of each gas passagewaies 50 and 60 in the electrolyte membrane 22 falls superfluously and good generation efficiency is maintained, reduction of the pressure loss at the time of gas passing each gas passagewaies 50 and 60 comes to be achieved.
[0056]Since each gas passagewaies 50 and 60 are set up for a long time than the length L2 in the direction to which a gas flow direction and the length L1 in a gas flow direction cross at right angles, The rate of flow of the gas in each gas passagewaies 50 and 60 is raised, the presentation of the gas in contact with each reaction electrodes 23 and 24 equalizes, and good generation efficiency comes to be secured.
[0057]Especially the improvement in such generation efficiency is checked by experiment according [becoming much more remarkable by having and setting up the relation which becomes L1/L2>2 about the length L1 in the gas flow direction of each gas passagewaies 50 and 60 and the length L2 in the direction which intersects perpendicularly with the gas flow direction] to an artificer.
[0058]As explained above, according to this embodiment, the following operation effects come to be obtained.
(1) While forming the communicating paths 52 and 62 which open for free passage the mainstream ways 51 and 61 where each gas passagewaies 50 and 60 adjoin each other, It can suppress that the blockade by the moisture liquefied to the downstream portion of each gas passagewaies 50 and 60 occurs, and good generation efficiency can be maintained now because the downstream set up relatively the communicated degree of the mainstream ways 51 and 61 by the communicating paths 52 and 62 greatly.

[0059](2) The upstream portion of each gas passagewaies 50 and 60 by having made it form by the linear shape parallel groove 801,901 without a crooked part. While being able to control that the moisture content of the portion located in the upstream of each gas passagewaies 50 and 60 in the electrolyte membrane 22 falls superfluously and being able to maintain good generation efficiency, the pressure loss at the time of gas passing each gas passagewaies 50 and 60 can be reduced.
[0060](3) By having set up the length L1 in the gas flow direction of each gas passagewaies 50 and 60 for a long time than the length L2 in the direction which intersects perpendicularly with the gas flow direction, the presentation of the gas in contact with each reaction electrodes 23 and 24 can be made to equalize, and good generation efficiency can be secured now.
[0061](4) The operation effect of the above (3) can be made much more remarkable by having a relation which becomes L1/L2>2 especially about each length L1 of each gas passagewaies 50 and 60, and L2, and having made it set up.
[0062](5) In addition, the circulating groove 800 which constitutes the fuel gas passage 50, and the circulating groove 900 which constitutes the oxidant gas passage 60 are written with symmetrical identical shape to the circumference of the medial axis C of the collecting electrode plate 10 prolonged in the direction which intersects perpendicularly with a gas flow direction, When laminating the collecting electrode plate 10 and the substrate 20, the work which distinguishes the field in which the fuel gas passage 50 was formed in the collecting electrode plate 10, and the field in which the oxidant gas passage 60 was formed becomes unnecessary. Therefore, the workability at the time of laminating the collecting electrode plate 10 and the substrate 20 can be raised now.
[0063]The collecting electrode plate concerning the embodiment described above can also change composition as follows.

- As shown in drawing 7 or drawing 8, in each crevice 505,506 of the lamination side which counters the negative pole 23 in the collecting electrode plate 10, The length in a gas flow direction constitutes the fuel gas passage 50 by the circulating groove 803 which forms two or more heights 509 set up so that the downstream might become short, and is formed among these heights 509. Similarly in each crevice 605,606 of the lamination side which counters the anode 24 in the collecting electrode plate 10, The length in a gas flow direction constitutes the oxidant gas passage 60 by the circulating groove (graphic display abbreviation) which forms two or more heights (graphic display abbreviation) set up so that the downstream might become short, and is formed among these heights.

[0064]Also by such composition, the downstream can set up relatively the communicated degree of each gas passagewaies 50 and 60 greatly, and a operation effect equivalent to the above-mentioned embodiment can be obtained.

[0065]As especially shown in drawing 8, diffusion of gas can be further promoted by shifting the position of the free passage portion of each gas passagewaies 50 and 60 (only the fuel gas passage 50 is shown in the figure) in a gas flow direction, and liquefaction of the moisture contained in the gas can be controlled now.

[0066]- Although a fixed interval is separated in a gas flow direction and the 2nd heights 508,608 were allocated in the above-mentioned embodiment, When the interval in which these 2nd heights 508,608 are allocated is expanded as the downstream of a gas flow direction and the downstream enlarges free passage area of the above-mentioned communicating paths 52 and 62, it may be made for the downstream of the gas flow direction to set up more greatly the communicated degree of each gas passagewaies 50 and 60.

[0067]- Although it provides each gas passageway 50, and two the air supplying openings 501,503,601,603 and the exhaust holes 502,504,602,604 for 60 at a time in the collecting electrode plate 10, respectively and two independent passages constituted each gas passagewaies 50 and 60 from the above-mentioned embodiment, respectively, It may be made to carry out **** composition of each gas passagewaies 50 and 60 at a respectively single passage.

[0068]- In the above-mentioned embodiment, although the 2nd heights 508,608 were made rectangular shape in section with the shape of a section square, the 1st heights 507,607, these heights 507,607,508,608 have such sectional shape -- it is not restricted, for example, may be made to make the 2nd heights 508,608 the shape of an elliptical cross section for the 1st heights 507,607 with section round shape.

[0069]- Although the above-mentioned embodiment showed the example of the collecting electrode plate with which the both sides of a fuel gas passage and an oxidant gas passage are formed, as for the collecting electrode plate, only one side may be formed among these each gas passageway.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention]This invention relates to the collecting electrode plate of the polymer electrolyte fuel cell with which either [at least] a fuel gas passage or an oxidant gas passage is formed in a lamination side with an electrolyte membrane.

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PRIOR ART

[Description of the Prior Art]One cell (unit cell) is constituted from the solid polymer type fuel cell by the electrolyte membrane which consists of solid polymer material, and the reaction electrodes (anode and negative pole) provided as sandwiched this electrolyte membrane from both sides. And while contacting the fuel gas which contains hydrogen in the negative pole, the oxidant gas which contains oxygen in the anode is contacted, He is trying to take out the electrical energy produced when the hydrogen ion which passes an electrolyte membrane from the negative pole and moves to the anode, and oxygen of the anode carry out a reduction reaction and water is generated from each reaction electrodes.
[0003]Since the electromotive force which can be taken out only by one unit cell has a limitation, he is trying to usually acquire desired electromotive force with a solid polymer type fuel cell by carrying out the plural laminates of the member called each unit cell and a collecting electrode plate by turns. This collecting electrode plate is formed with electrical conducting materials, such as carbon, and combines and has a function which forms the gas passageway for supplying fuel gas and oxidant gas between the surfaces of each reaction electrodes besides [which electrically connects each reaction electrodes] a function.
[0004]By the way, in a solid polymer type fuel cell, if the moisture content of an electrolyte membrane falls, while the ionic conductivity will fall and generation efficiency will fall, when the moisture content of an electrolyte membrane increases too much, diffusion of the gas in each reaction electrodes will be checked, and decline in generation efficiency will be caused too. For this reason, in a such solid polymer type fuel cell, when maintaining predetermined generation efficiency, it is necessary to manage the moisture content of an electrolyte membrane appropriately. For example, while a moisture content falls by the end side of the electrolyte membrane located in the upstream of the gas passageway when the water generated by the reduction reaction moves to the downstream with the gas of a gas passageway, When a moisture content increases too much by the other end side of the electrolyte membrane located in the downstream, decline in generation efficiency will be caused.
[0005]Then, while forming the gas passageway formed in each field of a collecting electrode plate by two or more parallel grooves so that the former, for example, JP,10-32011,A, may see, what set the flow of the gas of an adjacent slot as the direction which counters is known. According to such composition, since the average moisture distribution in each gas passageway of a collecting electrode plate becomes abbreviated homogeneity in a gas flow direction, the moisture content of an electrolyte membrane comes to be maintained appropriately.
[0006]However, since it is necessary to make the flow of the gas of the adjacent parallel groove formed in the same field counter mutually, avoiding complication of the gas passageway in a collecting electrode plate in such composition, cannot be finished. Then, it is possible to pass the fuel gas of the fuel gas passage formed in one field of a collecting electrode plate, and the oxidant gas of the oxidant gas passage formed in the field of the opposite hand to the direction which counters mutually.
[0007]While the downstream portion of the fuel gas passage where the moisture content of gas increases, and the upstream portion of the oxidant gas passage whose moisture content decreases come to be located in both sides on both sides of an electrolyte membrane in such composition, The upstream

portion of the fuel gas passage whose moisture content decreases, and the downstream portion of the oxidant gas passage where a moisture content increases come to be located in both sides on both sides of an electrolyte membrane. Therefore, without causing complication of the composition of each gas passageway, total of the moisture content supplied to an electrolyte membrane from the gas of each gas passageway, respectively can be maintained to approximately regulated in a gas flow direction, and the moisture content of the electrolyte membrane can be adjusted in optimum dose.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, when it is made to make the gas flow of fuel gas and oxidant gas counter in this way, the following inconvenience will arise about the gas in each gas passageway flowing.
[0009]That is, while the water generated by the reduction reaction by the anode side moves to the downstream of an oxidant gas passage with oxidant gas, the produced water which carried out back-diffusion of gas to the negative pole side through the electrolyte membrane from the anode side comes to move to the downstream of a fuel gas passage with fuel gas. And by movement of such moisture, by the downstream portion of each gas passageway, the concentration of the moisture contained in gas may rise too much, the moisture may liquefy, and each gas passageway may be closed. As a result, the flow of the gas in each gas passageway will come to be checked, and decline in generation efficiency will be caused.
[0010]this invention is made in view of such the conventional actual condition, and comes out. It is in the purpose suppressing that the blockade by the moisture liquefied to the downstream portion of ** occurs, and providing the collecting electrode plate of the polymer electrolyte fuel cell which can maintain good generation efficiency.

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MEANS

[Means for Solving the Problem]A means for attaining the above-mentioned purpose and its operation effect are indicated below. It is used for a polymer electrolyte fuel cell with which a fuel gas passage and an oxidant gas passage for passing fuel gas and oxidant gas in the invention according to claim 1 to direction which counters are established in the both sides on both sides of an electrolyte membrane, In a collecting electrode plate of a polymer electrolyte fuel cell with which at least one side of each of said gas passageway is formed in a lamination side with said electrolyte membrane, Said gas passageway is constituted by two or more channels, and while two or more communicating parts which open these next door **** channel for free passage are formed, a communicated degree by the communicating part is more greatly set up by the downstream of a gas flow direction.
[0012]According to composition indicated to above-mentioned claim 1, moisture contained in gas of a gas passageway increases like a downstream portion of the gas passageway, but. Since a communicated degree of a communicating part which opens for free passage a channel which adjoins each other in this downstream portion is set up greatly relatively, diffusion of gas is promoted in this communicating part, and liquefaction of moisture contained in the gas comes to be controlled.
[0013]On the other hand, in an upstream portion of a gas passageway, since a communicated degree of the above-mentioned communicating part is set up small relatively, diffusion of superfluous gas comes to be controlled. Therefore, a fall of a gas flow rate is suppressed and equalization of a presentation of gas in contact with an electrolyte membrane comes to be attained.
[0014]As a result, according to the above-mentioned composition, it can suppress that a blockade by moisture liquefied to a downstream portion of a gas passageway occurs, and good generation efficiency can be maintained now.
[0015]Like the above-mentioned composition, in order for the downstream of a gas flow direction to set up a communicated degree of a communicating part more greatly, the downstream sets up formation density of a communicating part more greatly, or composition that the downstream sets up free passage area of a communicating part more greatly can be adopted, for example.
[0016]Said gas passageway can also be materialized as composition that a downstream portion is formed of a grating groove while an upstream portion is formed of a parallel groove so that an invention indicated to claim 1 may be indicated to claim 2.
[0017]In a collecting electrode plate of a polymer electrolyte fuel cell which the invention according to claim 3 indicated to claim 2, said parallel groove supposes that it is what is formed in linear shape without a crooked part.
[0018]According to the above-mentioned composition, in an upstream portion of a gas passageway, as compared with a case where a grating groove constitutes the gas passageway, for example, surface area in contact with gas of an electrolyte membrane becomes small, and a total amount of moisture away held from an electrolyte membrane by gas which flows through a gas passageway decreases. Flow resistance at the time of gas passing an upstream portion of a gas passageway also comes to fall. Therefore, while being able to control that a moisture content of a portion located in the upstream of a gas passageway in an electrolyte membrane, respectively falls superfluously and being able to maintain good generation

efficiency, pressure loss at the time of gas passing a gas passageway can be reduced.
[0019]In the invention according to claim 4, said gas passageway supposes that the length L1 in a gas flow direction is what is set up for a long time than the length L2 in a direction which intersects perpendicularly with a gas flow direction in a collecting electrode plate of the polymer electrolyte fuel cell according to any one of claims 1 to 3.
[0020]By setting up the length L1 in a gas flow direction of a gas passageway for a long time than the length L2 in a direction which intersects perpendicularly with the gas flow direction according to the above-mentioned composition, Can raise the rate of flow of gas in a gas passageway, a presentation of gas in contact with an electrolyte membrane can be made to equalize, and good generation efficiency can be secured now.
[0021]In [so that according to the invention according to claim 5] a collecting electrode plate of the polymer electrolyte fuel cell according to claim 4, By adopting composition that the length L2 in a direction which intersects perpendicularly with the length L1 and a gas flow direction in said gas flow direction is what has a becoming relation and is set up L1/L2>2, a operation effect by invention indicated to above-mentioned claim 4 can be made much more remarkable.
[0022]
[Embodiment of the Invention]Hereafter, one embodiment of this invention is described with reference to drawing 1 - drawing 6. Drawing 1 shows the strabism structure of the polymer electrolyte fuel cell 30 where the collecting electrode plate 10 concerning this embodiment is used.
[0023]As shown in drawing 1, the fuel cell 30 is provided with the substrate 20 and the collecting electrode plate 10 which were laminated by turns, and the side plate 40 of the couple which sandwiches the layered product which consists of these substrates 20 and the collecting electrode plate 10 from both sides, and is constituted.
[0024]Drawing 2 is parallel to the section structure of the above-mentioned layered product which met two to 2 line of drawing 1, i.e., the gas flow direction of each gas passagewaies 50 and 60 mentioned later, and shows the section structure along the flat surface which extends in the laminating direction of the substrate 20 and the collecting electrode plate 10.
[0025]As shown in the drawing 2, it has the substrate 20 with the reaction electrodes (the negative pole 23 and anode 24) which sandwich the electrolyte membrane 22 and this electrolyte membrane 22 from both sides, and it is constituted. In the moderate damp or wet condition, the electrolyte membrane 22 shows ion conductivity, for example, is formed with polymer materials, such as fluororesin. The reaction electrodes 23 and 24 are formed of carbon fiber including the catalyst of platinum etc.
[0026]On the other hand, the collecting electrode plate 10 is formed in rectangular plate shape with electrical conducting materials, such as carbon. This collecting electrode plate 10 combines and has a function which forms the gas passagewaies 50 and 60 for supplying fuel gas and oxidant gas between the surfaces of each reaction electrodes 23 and 24 besides [which electrically connects each reaction electrodes 23 and 24] a function.
[0027]In this collecting electrode plate 10, while counters with the negative pole 23 among the above-mentioned reaction electrodes 23 and 24, and drawing 3 shows the lamination side. As shown in the figure, the fuel gas passage 50 for passing fuel gas, such as hydrogen gas, is formed in this lamination side. Drawing 5 shows the lamination side of the anode 24 and another side which counters among the above-mentioned reaction electrodes 23 and 24 in the collecting electrode plate 10. As shown in the figure, in the collecting electrode plate 10, the oxidant gas passage 60 for passing oxidant gas, such as air, is formed in the anode 24 and the lamination side which counters.
[0028]As shown in these each figure, in the end part (it is [in / on drawing 3 and / a right end section and drawing 5] a left edge part) of the collecting electrode plate 10. While the 1st air supplying opening 501 and 2nd air supplying opening 503 for supplying fuel gas to the fuel gas passage 50 are formed, in the position which adjoins these each air supplying opening 501,503, respectively. The 1st exhaust hole 602 and 2nd exhaust hole 604 for discharging oxidant gas from the oxidant gas passage 60 are formed.
[0029]On the other hand, to the other end (it is [in / on drawing 3 and / a left edge part and drawing 5] a right end section) of the collecting electrode plate 10. While the 1st exhaust hole 502 and 2nd exhaust

hole 504 for discharging fuel gas from the fuel gas passage 50 are formed, in the position which adjoins these each exhaust hole 502,504, respectively. The 1st air supplying opening 601 and 2nd air supplying opening 603 for supplying oxidant gas to the oxidant gas passage 60 are formed.
[0030]Thus, each air supplying opening 501,503 of the fuel gas passage 50, each air supplying opening 601,603 of the oxidant gas passage 60, and each exhaust hole 502,504 of the fuel gas passage 50 and each exhaust hole 602,604 of the oxidant gas passage 60, Since it is formed in the end of the opposite hand of the collecting electrode plate 10, respectively, as an arrow shows to drawing 2, respectively, in each gas passagewaies 50 and 60, fuel gas and oxidant gas counter mutually substantially, and come to flow for reverse.
[0031]And by setting up the flow direction of the gas in each gas passagewaies 50 and 60 for reverse in this way, Total of the moisture content supplied to the electrolyte membrane 22, respectively serves as approximately regulated from fuel gas and oxidant gas in the gas flow direction of each gas passagewaies 50 and 60, and the moisture content of the electrolyte membrane 22 comes to be maintained by optimum dose.
[0032]In the collecting electrode plate 10, the water supply hole 701 for supplying cooling water to the cooling water passage (graphic display abbreviation) formed in the inside of the collecting electrode plate 10 is formed between the 1st exhaust hole 602 for oxidant gas passage 60, and the 2nd air supplying opening 503 for fuel gas passage 50. Between the 2nd air supplying opening 603 for oxidant gas passage 60, and the 1st exhaust hole 502 for fuel gas passage 50, the drain hole 702 for discharging cooling water from the above-mentioned cooling water passage is formed.
[0033]On the other hand, in the state where the substrate 20 laminated with the collecting electrode plate 10, the hole (graphic display abbreviation) is formed in each holes 501-504,601-604, and 701,702 of the collecting electrode plate 10, and a corresponding position, respectively. In the state where the collecting electrode plate 10 and the substrate 20 were laminated, the holes 501-504,601-604 and 701,702 comrades which were formed in the position to which the collecting electrode plate 10 corresponds, respectively come to be opened for free passage through the hole formed in this substrate 20.
[0034]As shown in drawing 3, as the 1st air supplying opening 501 and 1st exhaust hole 502 for fuel gas passage 50 are connected with the negative pole 23 and the lamination side which counters, the crevice 505 is formed in it in the collecting electrode plate 10. Similarly, in the collecting electrode plate 10, as the 2nd air supplying opening 503 and 2nd exhaust hole 504 for fuel gas passage 50 are connected with the negative pole 23 and the lamination side which counters, another crevice 506 is formed in it along with the above-mentioned crevice 505.
[0035][in these each crevice 505,506] to the upstream in the position of each air supplying opening 501,503 slippage, i.e., the substantial gas flow direction of the fuel gas passage 50, (in drawing 3, it is a longitudinal direction). The 1st heights 507 of the rectangular shape in section prolonged along the gas flow direction separate a fixed interval, and are formed. [two or more]
[0036]On the other hand, [in each crevice 505,506], in the position of each exhaust hole 502,504 slippage, i.e., the downstream in a gas flow direction. The 2nd heights 508 that make the shape of a section square are located on the same straight line as each 1st heights 507, and a respectively fixed interval is separated in a gas flow direction and the direction, and the direction that intersects perpendicularly, and more than one are formed.
[0037]All, in the state where the collecting electrode plate 10 and the substrate 20 were laminated, these 1st heights 507 and the 2nd heights 508 touch the negative pole 23 of the substrate 20, as shown in drawing 2.
[0038]And the circulating groove 800 for passing fuel gas by the 1st heights 507 and 2nd heights 508 is formed in each crevice 505,506, and the fuel gas passage 50 is constituted by these each circulating groove 800. This fuel gas passage 50 is set up for a long time than the length L2 (refer to drawing 3) in the direction to which that gas flow direction and the length L1 (refer to drawing 3) in a gas flow direction cross at right angles. In detail, these each length L1 and L2 are set up, respectively so that the relation which becomes L1/L2>2 may be materialized.
[0039]As shown in drawing 4, the above-mentioned circulating groove 800 is constituted by the parallel

groove 801 formed between each 1st heights 507, and the grating groove 802 formed between each 2nd heights 508. This parallel groove 801 has linear shape without a crooked part, and is located in the upstream in a gas flow direction. On the other hand, the grating groove 802 is located in the downstream in a gas flow direction.

[0040]In each crevice 505,506, two or more linear shape channels (henceforth a "mainstream way") 51 are formed of the portion and the parallel groove 801 which extend in a gas flow direction in the grating groove 802. And the these next door **** mainstream way 51 is mutually opened for free passage by the channel (henceforth a "communicating path") 52 formed of the portion prolonged in the direction which intersects perpendicularly with a gas flow direction in the grating groove 802. Since the grating groove 802 is formed in each crevice 505,506 only at the downstream of the gas flow direction, as for the communicating path 52, the way of the downstream is greatly set up for the formation density to the upstream. That is, the communicated degree of the mainstream way 51 by this communicating path 52 is relatively set up greatly like the downstream.

[0041]As shown in drawing 5, as the 1st air supplying opening 601 and 1st exhaust hole 602 corresponding to the oxidant gas passage 60 are connected with the anode 24 and the lamination side which counters, the crevice 605 is formed in it in the collecting electrode plate 10. Similarly, in the collecting electrode plate 10, as the 2nd air supplying opening 603 and 2nd exhaust hole 604 corresponding to the oxidant gas passage 60 are connected with the anode 24 and the lamination side which counters, another crevice 606 is formed in it along with the above-mentioned crevice 606.

[0042][in these each crevice 605,606] to the upstream in the position of each air supplying opening 601,603 slippage, i.e., the substantial gas flow direction of the oxidant gas passage 60, (in drawing 5, it is a longitudinal direction). The 1st heights 607 of the rectangular shape in section prolonged along the gas flow direction separate a fixed interval, and are formed. [two or more]

[0043]On the other hand, [in each crevice 605,606], in the position of each exhaust hole 602,604 slippage, i.e., the downstream in a gas flow direction. The 2nd heights 608 that make the shape of a section square are located on the same straight line as each 1st heights 607 of the above, and a respectively fixed interval is separated in a gas flow direction and the direction, and the direction that intersects perpendicularly, and more than one are formed.

[0044]All, in the state where the collecting electrode plate 10 and the substrate 20 were laminated, these 1st heights 607 and the 2nd heights 608 touch the anode 24 of the substrate 20, as shown in drawing 2.

[0045]And the circulating groove 900 for passing oxidant gas by the 1st heights 607 and 2nd heights 608 is formed in each crevice 605,606. This circulating groove 900 has the circulating groove 800 which constitutes the above-mentioned fuel gas passage 50 in the circumference of the medial axis C of the collecting electrode plate 10 prolonged in the direction which intersects perpendicularly with the flow of gas (refer to drawing 5), and the same symmetrical shape.

[0046]The oxidant gas passage 60 is constituted by each circulating groove 900. In this oxidant gas passage 60, the length L2 (refer to drawing 5) in the direction to which that gas flow direction and the length L1 (refer to drawing 5) in a gas flow direction cross at right angles is set up like the above-mentioned fuel gas passage 50 for a long time than twice (L2x2). In detail, these each length L1 and L2 are set up, respectively so that the relation which becomes L1/L2>2 may be materialized. Thus, by having the above-mentioned relation and setting up the length L1 of each gas passagewaies 50 and 60 of the collecting electrode plate 10, and L2, shape of the fuel cell 30 can be made into flat shape, and it also becomes possible to carry the fuel cell 30 in narrow space, such as an under floor of vehicles.

[0047]As shown in drawing 6, the above-mentioned circulating groove 900 is constituted by the parallel groove 901 formed between each 1st heights 607, and the grating groove 902 formed between each 2nd heights 608. This parallel groove 901 has linear shape without a crooked part, and is located in the upstream in a gas flow direction. On the other hand, the grating groove 902 is located in the downstream in a gas flow direction.

[0048]In each crevice 605,606, two or more linear shape channels (henceforth a "mainstream way") 61 are formed of the portion and the parallel groove 901 which extend in a gas flow direction in the grating groove 902. And the these next door **** mainstream way 61 is mutually opened for free passage by

the channel (henceforth a "communicating path") 62 formed of the portion prolonged in the direction which intersects perpendicularly with a gas flow direction in the grating groove 902. Since the grating groove 902 is formed in each crevice 605,606 only at the downstream of the gas flow direction, as for the communicating path 62, the way of the downstream is greatly set up for the formation density to the upstream. That is, the communicated degree of the mainstream way 61 by this communicating path 62 is relatively set up greatly like the downstream.

[0049]Next, in the collecting electrode plate 10 constituted as mentioned above, it explains that the fuel gas in each gas passageway 50 and 60 and oxidant gas flow. After fuel gas is introduced in each crevice 505,506 through each air supplying opening 501,503 for fuel gas passage 50, it passes through each parallel groove 801, and comes to flow into the downstream. After being similarly introduced in each crevice 605,606 through each air supplying opening 601,603 for oxidant gas passage 60 about oxidant gas, it passes through each parallel groove 901, and comes to flow into the downstream.

[0050]Thus, the fuel gas which moved each parallel groove 801 to the downstream is discharged through each exhaust hole 502,504, after passing the grating groove 802 further. After passing the grating groove 902 from each parallel groove 801 similarly about oxidant gas, it is discharged through each exhaust hole 602,604.

[0051]Therefore, as the arrow A shows to drawing 4, in the mainstream way 51 of the fuel gas passage 50. As the substantial flow of the fuel gas which goes to each exhaust hole 502,504 from each air supplying opening 501,503 comes to be formed and the arrow A shows to drawing 6, The substantial flow of the oxidant gas which goes to each exhaust hole 602,604 from each air supplying opening 601,603 comes to be formed in the mainstream way 61 of the oxidant gas passage 60.

[0052]With the flow of the substantial gas in each such mainstream ways 51 and 61, in addition, since the communicating paths 52 and 62 which open the adjacent mainstream ways 51 and 61 for free passage are formed in each gas passagewaies 50 and 60, As the arrow B shows to drawing 4 and drawing 6, it comes to diffuse a part of gas in the direction which intersects perpendicularly with the substantial flow direction of gas through these communicating paths 52 and 62.

[0053]That communicated degree is relatively set up for the downstream greatly, these communicating paths 52 and 62 are hurt, in the downstream portion of each gas passagewaies 50 and 60, in these communicating paths 52 and 62, diffusion of gas will come to be promoted more, and liquefaction of the moisture contained in the gas will be controlled. On the other hand, in the upstream portion of each gas passagewaies 50 and 60, since the communicated degree of the communicating paths 52 and 62 is set up small relatively, superfluous diffusion comes to be controlled. Therefore, the fall of a gas flow rate is suppressed and equalization of a presentation of gas in contact with each reaction electrodes comes to be attained.

[0054]As a result, it is controlled that the blockade by the moisture liquefied to the downstream portion of each gas passagewaies 50 and 60 occurs, and good generation efficiency comes to be maintained. The upstream portion of each gas passagewaies 50 and 60, Since it is formed of the linear shape parallel groove 801,901 without a crooked part, for example as compared with a grating groove etc., the surface area in contact with the gas of the electrolyte membrane 22 becomes small, and the total amount of the moisture away held from the electrolyte membrane 22 by the gas which flows through each gas passagewaies 50 and 60 decreases. The flow resistance at the time of gas passing the upstream portion of each gas passagewaies 50 and 60 also comes to fall.

[0055]As a result, while it is suppressed that the moisture content of the portion located in the upstream of each gas passagewaies 50 and 60 in the electrolyte membrane 22 falls superfluously and good generation efficiency is maintained, reduction of the pressure loss at the time of gas passing each gas passagewaies 50 and 60 comes to be achieved.

[0056]Since each gas passagewaies 50 and 60 are set up for a long time than the length L2 in the direction to which a gas flow direction and the length L1 in a gas flow direction cross at right angles, The rate of flow of the gas in each gas passagewaies 50 and 60 is raised, the presentation of the gas in contact with each reaction electrodes 23 and 24 equalizes, and good generation efficiency comes to be secured.

[0057]Especially the improvement in such generation efficiency is checked by experiment according [becoming much more remarkable by having and setting up the relation which becomes L1/L2>2 about the length L1 in the gas flow direction of each gas passagewaies 50 and 60 and the length L2 in the direction which intersects perpendicularly with the gas flow direction] to an artificer.
[0058]As explained above, according to this embodiment, the following operation effects come to be obtained.
(1) While forming the communicating paths 52 and 62 which open for free passage the mainstream ways 51 and 61 where each gas passagewaies 50 and 60 adjoin each other, It can suppress that the blockade by the moisture liquefied to the downstream portion of each gas passagewaies 50 and 60 occurs, and good generation efficiency can be maintained now because the downstream set up relatively the communicated degree of the mainstream ways 51 and 61 by the communicating paths 52 and 62 greatly.

[0059](2) The upstream portion of each gas passagewaies 50 and 60 by having made it form by the linear shape parallel groove 801,901 without a crooked part. While being able to control that the moisture content of the portion located in the upstream of each gas passagewaies 50 and 60 in the electrolyte membrane 22 falls superfluously and being able to maintain good generation efficiency, the pressure loss at the time of gas passing each gas passagewaies 50 and 60 can be reduced.
[0060](3) By having set up the length L1 in the gas flow direction of each gas passagewaies 50 and 60 for a long time than the length L2 in the direction which intersects perpendicularly with the gas flow direction, the presentation of the gas in contact with each reaction electrodes 23 and 24 can be made to equalize, and good generation efficiency can be secured now.
[0061](4) The operation effect of the above (3) can be made much more remarkable by having a relation which becomes L1/L2>2 especially about each length L1 of each gas passagewaies 50 and 60, and L2, and having made it set up.
[0062](5) In addition, the circulating groove 800 which constitutes the fuel gas passage 50, and the circulating groove 900 which constitutes the oxidant gas passage 60 are written with symmetrical identical shape to the circumference of the medial axis C of the collecting electrode plate 10 prolonged in the direction which intersects perpendicularly with a gas flow direction, When laminating the collecting electrode plate 10 and the substrate 20, the work which distinguishes the field in which the fuel gas passage 50 was formed in the collecting electrode plate 10, and the field in which the oxidant gas passage 60 was formed becomes unnecessary. Therefore, the workability at the time of laminating the collecting electrode plate 10 and the substrate 20 can be raised now.
[0063]The collecting electrode plate concerning the embodiment described above can also change composition as follows.
- As shown in drawing 7 or drawing 8, in each crevice 505,506 of the lamination side which counters the negative pole 23 in the collecting electrode plate 10, The length in a gas flow direction constitutes the fuel gas passage 50 by the circulating groove 803 which forms two or more heights 509 set up so that the downstream might become short, and is formed among these heights 509. Similarly in each crevice 605,606 of the lamination side which counters the anode 24 in the collecting electrode plate 10, The length in a gas flow direction constitutes the oxidant gas passage 60 by the circulating groove (graphic display abbreviation) which forms two or more heights (graphic display abbreviation) set up so that the downstream might become short, and is formed among these heights.
[0064]Also by such composition, the downstream can set up relatively the communicated degree of each gas passagewaies 50 and 60 greatly, and a operation effect equivalent to the above-mentioned embodiment can be obtained.
[0065]As especially shown in drawing 8, diffusion of gas can be further promoted by shifting the position of the free passage portion of each gas passagewaies 50 and 60 (only the fuel gas passage 50 is shown in the figure) in a gas flow direction, and liquefaction of the moisture contained in the gas can be controlled now.
[0066]- Although a fixed interval is separated in a gas flow direction and the 2nd heights 508,608 were allocated in the above-mentioned embodiment, When the interval in which these 2nd heights 508,608

are allocated is expanded as the downstream of a gas flow direction and the downstream enlarges free passage area of the above-mentioned communicating paths 52 and 62, it may be made for the downstream of the gas flow direction to set up more greatly the communicated degree of each gas passagewaies 50 and 60.

[0067]- Although it provides each gas passageway 50, and two the air supplying openings 501,503,601,603 and the exhaust holes 502,504,602,604 for 60 at a time in the collecting electrode plate 10, respectively and two independent passages constituted each gas passagewaies 50 and 60 from the above-mentioned embodiment, respectively, It may be made to carry out **** composition of each gas passagewaies 50 and 60 at a respectively single passage.

[0068]- In the above-mentioned embodiment, although the 2nd heights 508,608 were made rectangular shape in section with the shape of a section square, the 1st heights 507,607, these heights 507,607,508,608 have such sectional shape -- it is not restricted, for example, may be made to make the 2nd heights 508,608 the shape of an elliptical cross section for the 1st heights 507,607 with section round shape.

[0069]- Although the above-mentioned embodiment showed the example of the collecting electrode plate with which the both sides of a fuel gas passage and an oxidant gas passage are formed, as for the collecting electrode plate, only one side may be formed among these each gas passageway.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The perspective view showing the laminated structure of a fuel cell.
[Drawing 2]The fragmentary sectional view which met two to 2 line of drawing 1.
[Drawing 3]The top view showing the fuel gas passage formed in the lamination side of the negative pole and the collecting electrode plate which counters.
[Drawing 4]The enlarged plan view expanding and showing the circulating groove which constitutes a fuel gas passage.
[Drawing 5]The top view showing the oxidant gas passage formed in the lamination side of the anode and the collecting electrode plate which counters.
[Drawing 6]The enlarged plan view expanding and showing the circulating groove which constitutes an oxidant gas passage.
[Drawing 7]The top view showing the composition modification of a gas passageway.
[Drawing 8]The top view showing the composition modification of a gas passageway.
[Description of Notations]
10 [-- The negative pole, 24 / -- Anode,] -- A collecting electrode plate, 20 -- A substrate, 22 -- An electrolyte membrane, 23 30 -- A polymer electrolyte fuel cell, 50 -- A fuel gas passage, 51 -- Mainstream way, 52 [-- Communicating path,] -- A communicating path, 60 -- An oxidant gas passage, 61 -- A mainstream way, 62 501 -- The 1st air supplying opening, 502 -- The 1st exhaust hole, 503 -- The 2nd air supplying opening, 504 -- The 2nd exhaust hole, 505,506 -- A crevice, 507 -- The 1st heights, 508 [-- The 1st exhaust hole,] -- The 2nd heights, 509 -- Heights, 601 -- The 1st air supplying opening, 602 603 -- The 2nd air supplying opening, 604 -- The 2nd exhaust hole, 605,606 -- Crevice, 607 [-- A drain hole, 800 / -- A circulating groove, 801 / -- A parallel groove, 802 / -- A grating groove, 803 / -- A circulating groove, 900 / -- A circulating groove, 901 / -- A parallel groove, 902 / -- Grating groove.] -- The 1st heights, 608 -- The 2nd heights, 701 -- A water supply hole, 702

[Translation done.]